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On Fetal-Tissue Ban, DARPA, Global Change

Q&A With D. Allan Bromley, Bush's Science Adviser

D. Allan Bromley, the President's Science Adviser and Director of the Office of Science and Technology Policy, spoke with SGR Editor Greenberg on May 15. Following is the text, transcribed and edited by SGR.

SGR. *The restrictions on federal support for experiments involving transplantation of fetal tissues have exasperated and dismayed many people. What is the rationale for this limitation on promising research?*

Bromley. The rationale, as best I understand it, is that the use of fetal tissue provides, potentially, an argument in favor of abortion. It's a second-order argument. It's one that I certainly keep out of, because that transcends matters of science and technology.

SGR. *It has shut off a very important line of research.*

Bromley. In that sense. But I think that it has triggered a possibility of much of that research proceeding. Now the challenge has led to a number of new developments for the proliferation of cell lines and the development of fetal cell lines *in vitro* that will be important.

SGR. *It would be far simpler to do this research directly with the tissue.*

Bromley. There is no question that in many of the present cases that are being demonstrated abroad, the use of fetal tissue has produced results that are exciting and that are certainly at the forefront in a number of fields of research. The decision not to follow that here is certainly not a scientific one.

SGR. *It is a political decision?*

Bromley. Not a scientific one.

SGR. *It's not anything you were involved with, one way or the other?*

Bromley. I was not involved.

SGR. *Was your advice sought on this?*

Bromley. No. This whole thing happened before I was here in place.

SGR. *But the reaffirmation of the restrictions was made just last month.*

Bromley. I was not involved with that.

SGR. *It has also radiated a malign influence on the efforts to fill the Directorship of NIH.*

Bromley. Yes. The Directorship of NIH I look on as an extraordinarily important position, the most important that is not filled at the moment. The thing that concerns me there is that, structurally, it is very important for the Director of NIH to be upgraded substantially. As things now stand, the Director of NIH has a lot of bureaucracy above him or her in HHS [Department of Health and Human Services, parent

agency of NIH]. Certainly I will do everything I can to see if we can upgrade the position. An example would be NOAA [National Oceanic and Atmospheric Administration] in the Department of Commerce, where the Director of NOAA is an Under Secretary and reports directly to the Secretary of Commerce. I would certainly like to see some upgrading of the whole NIH structure, within the HHS environment.

SGR. *Can you explain why Craig Fields was ousted as*
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In Brief

On the eve of departure, NSF Director Erich Bloch is quietly aiming for a major reorganization of the Foundation's education programs. Bloch, completing a six-year term in August, wants to establish a super Directorate for Education and Human Resources, replacing the present setup, which shares educational responsibilities with other parts of the Foundation.

The unannounced swan-song reorganization is viewed with suspicion by Washington's militant science-education lobby, which has long complained about its share of the NSF budget. To Bloch's annoyance, sympathetic Congressional committees have frequently dipped into NSF's research accounts to beef up the education programs, which Assistant Director for Education Bassam Z. Shakhshiri has widely described as inadequately supported. Shakhshiri's fate in the proposed reorganization is unclear.

Far out front in gambit of the year for federal bucks: The American Institute of Aeronautics and Astronautics, which is calling for construction of three or four telescopes, at \$2-3 million each, to look out for heavy asteroids on collision courses with the earth. In a position paper titled "Dealing With the Threat of an Asteroid Striking the Earth," the AIAA also calls for exploring methods to alter asteroid "orbits sufficiently to preclude impact."

Applications have gone way up and the chances of getting a grant have gone down at major federal granting agencies in recent years, according to a new study by the Congressional Office of Technology Assessment, Proposal Pressure in the 1980s: An Indicator of Stress on the Federal Research System. In 1977, NSF reviewed 14,499 applications and funded 45.6 percent; in 1988, it reviewed 26,802 and funded 28.2 percent. A limited number of copies of the report are available from: US Congress, Office of Technology Assessment, Science, Education and Transportation Program, Washington, DC 20510-8025.

... Says Ouster of DARPA Chief is Misunderstood

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head of DARPA [Defense Advanced Research Projects Agency]?

Bromley. I can't tell you all the details, but I can tell you, without the slightest question, that it has been widely misinterpreted. The change in his position [to Deputy Director, Defense Research and Engineering, for Defense Management Report Implementation] isn't to utter darkness, incidentally. He's been asked to take over a very important job, which is restructuring the Defense Department's laboratories. I understand the perception. But it had nothing to do with industrial policy or any change in this Administration's policy. It was purely an internal question within the Defense Department.

SGR. What was the question?

Bromley. It was simply a question of a disagreement on procedures, not on any specific grant, contract, support, or anything of that sort. But, specifically, how to operate within a structure.

SGR. Disagreement on which procedures?

Bromley. I can't tell you specifically the things that led to this, but it was a difference of opinion between Craig and his superiors on how one should carry out some procedures.

SGR. On some purely administrative matter?

Bromley. Exactly.

SGR. No ideological content concerning the appropriate federal role in assisting industry?

Bromley. Absolutely no ideological content. That I can assure you.

SGR. Why hasn't some effort been made to counter the general impression that Fields was kicked out because John Sununu [the White House Chief of Staff] and others felt he was getting the federal government too closely involved with helping industry?

Bromley. Because the worry has been that to do so, on a lot of people's part, at least, would damage Craig Fields. And I think we've all worried about that, because we all certainly have enormously high regard for Craig and for his abilities. As a technologist, he's one of the best we have in the entire government. And I deeply regret that this came about, because we're going to really miss his leadership at DARPA.

SGR. He's pretty sturdy. I don't think there has to be concern about damaging him.

Bromley. Nonetheless, when there are very specific administrative questions that lead to a—then, certainly, I'm not going to talk about them outside of the Defense Department. But I can and will emphasize as solidly as I possibly can that there was nothing to do with differences of opinion about the direction of DARPA, the kind of funding that DARPA was doing, or what Craig had in mind. That had nothing to do with it. Absolutely nothing to do with it. That's what makes it sad.

SGR. DARPA was taking on a role that some people

define as or equate with "industrial policy," whatever that loosely used term means.

Bromley. That was the claim. Frankly, I don't think it was industrial policy. I think what he was doing was very clearly still in the realm of technology policy, which I would define differently. Industrial policy I take as being a situation where somebody in Washington goes out and picks winners and losers in the production stage of something or other. And I remain convinced, as I think do most of the people here, that we don't know as much about how that should be done as people in the private sector. So we've been staying out of that.

But I do feel that we have a very important role to play in that range from basic discovery up to the point of production, the pre-competitive phase, particularly in the case of generic technologies. And that's where DARPA has played and continues to play a very important role.

Sematech Model

SGR. Where does Sematech [an industrial consortium to which the Pentagon contributes \$100 million a year for research on semiconductor manufacturing] fit into this policy?

Bromley. Sematech is a particular example of one of the very important "enabling" technologies—the semiconductor technology that underlies so much of our economic competitiveness, national security, just about everything we do.

SGR. Sematech is a manufacturing operation.

Bromley. Sematech is manufacturing only in the sense that if you're really going to develop manufacturing technologies, you've got to do a little manufacturing, or you'll never know what you've got. But they're not manufacturing in competition with the world. It really is an attempt, and I think a good one, to develop the kind of technologies that can then be spread out to the participants, rather than having each of them try to reinvent the wheels that are needed in parallel. This way, you reduce the cost, you reduce the risk,

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... Denies Friction with Sununu on Global Change

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and hopefully you speed it up.

SGR. *Would the Administration contemplate clones of Sematech in other technologies or other fields of manufacturing?*

Bromley. We are contemplating such.

SGR. *What are examples of that?*

Bromley. Premature. But I have stated in a number of recent testimonies [in Congress] that I feel Sematech is in many ways a model for what we should do in other technologies.

SGR. *So you would then contemplate a number of firms in the same industry getting together, with government assistance, to develop manufacturing technologies, as Sematech is doing for semiconductors.*

Bromley. If that is the particular thing. There may be other technologies which may be important that aren't so much focused directly on manufacturing. But, clearly, that's the sort of thing that I think we have to do to level the playing field a bit.

SGR. *Would this responsibility, financially and administratively, be assigned to the Defense Department, or would it go to NIST [National Institute of Standards and Technology] and its Advanced Technology Program?*

Bromley. Some would obviously go to the Defense Department, but I would hope that, increasingly, this kind of support would go to the Advanced Technology Program. I'd like to see that program expanded. I look upon it this year as something of a pilot program and I hope that we can expand that substantially.

SGR. *Right now it's only \$10 million.*

Bromley. It's premature to say this early in the budget cycle how much we'll try to get for it. But a lot will depend on what happens in that program in the next six months.

No Civilian DARPA

SGR. *Do you look upon NIST's Advanced Technology Program as potentially the often-referred-to civilian DARPA?*

Bromley. No. One of the reasons that I think DARPA has been as successful as it has is that it's had a very clearly identified customer. And so you could make the decisions about allocation of funding with that in the back of your mind.

The civilian DARPA that a lot of people suggest, and that superficially looks very attractive to many, has the real problem that you don't have that focus. And I haven't yet seen a way to do the funding allocation without having it turn into a series of tremendous pressures from the Congress, from God knows where, to make specific decisions to fund specific pet projects. One of the things that the Advanced Technology Program in NIST will demonstrate is the success that they have in making this kind of decision.

If it's successful, I would hope that it would expand relatively quickly. In fact, I think that one could make a very good case for substantial increases there, because NIST is one of the very few agencies here that really has a track record of working with industry. In areas of specialization NIST has very good working relations that I hope we can expand and use.

SGR. *It is widely perceived that under [White House Chief of Staff] John Sununu's domination, science is taking second place to economic considerations in global-change policy.*

Bromley. I don't think that's true at all. The fact is that we know a helluva lot more about the science of global change than we do about the economics. When Bill Reilly [Administrator of the Environmental Protection Agency] and I came back from Noordwijk [in the Netherlands, site of a global change conference] last November, the thing that was most apparent to both of us was that country after country was prepared to sign up for a 20 percent reduction [in carbon dioxide emissions] without having any real understanding or analysis that we could discern of what this was going to cost, how they were going to do it.

And so, when we came back that was something that we talked to the President about. The President said, "Why don't you do something?" And it was out of that this White House conference [on global change, including economic effects] developed a few weeks ago. And I think it really reflects our desire to get as balanced a base for policy decisions as we can.

Most of the work in global change has been on the input side—how do you get to global change, how does it occur, how big is it? And relatively little on the output side: What would it do to things like agricultural productivity, sea levels, storm severity, all these things that have economic consequences? When I took over as Chairman of the DPC [Domestic Policy Council] Working Group on Global Change, one of the first things I did was to get the Department of the Interior to try to pull together what the private sector knew about global change, because that's a resource we hadn't really touched on before. Secondly, to get the Council of Economic Advisers to do some economic modeling to give us some feeling for what various scenarios would really cost. And the thing that emerged from that, of course, was that there were enormous uncertainties, because of uncertainties in our understanding of the science.

And so, by getting the scientists and the economists together, our hope is that we will at least identify where to put our resources in making measurements so that we can reduce the critical scientific parameters. There are so many things to measure that you could dribble away an enormous amount of money measuring parameters that aren't very important. You want to focus on the ones that really affect the economics, so that we can get some feeling of how we

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... "Dumb" to Try to Control Global Change Meeting

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can quantify the various scenarios that people are talking about before we go into this Second World Climate Convention [November, in Geneva], for example.

SGR. All these things are desirable, but it is, again, widely perceived that you and Reilly are much more interested at this point in taking some positive steps about emission reduction than Sununu is.

Bromley. That's not fair, either. There's a great attempt on the part of a lot of people in the press to run a wedge somewhere through the White House, peel off maybe at Sununu and [Richard] Darman [Director of the Office of Management and Budget] on one day, or maybe it's me and Sununu on another.

The fact is that there isn't really all that disagreement at all, and the important thing is that we all agree that, even at this moment, we don't have a good enough understanding of the economics to really embark on major programs of amelioration. But what we do all agree on is that there are a helluva lot of things that we can and should be doing that will greatly improve the greenhouse problem, but which we will do for other perfectly good reasons, too.

They involve the massive emphasis on energy conservation that's going into the National Energy Strategy that Jim Watkins [Secretary of the Department of Energy] is putting together. They involve the phasing out of the CFCs [chlorofluorocarbons] prior to 2000, ahead of the Montreal Protocol, assuming we've got satisfactory substitutes, and we have every belief we will. They involve, in the Clean Air legislation, having a substantial impact on greenhouse emissions. Those are things on the source side.

On the sink side, the Department of Agriculture proposal to plant a billion trees to soak up 13 million tons of carbon dioxide per year; negotiations with the Brazilians, with other tropical countries, in terms of debt-for-nature swaps certainly work toward source reduction of greenhouse gases.

But the important thing is that that's not the reason necessarily that we're doing them. We're doing them because, for example, we want to protect the gene pool in those areas. There are all sorts of good reasons. I look on that as an insurance policy.

Global Change Conference

SGR. Many foreign participants complained that the recent White House Conference on global change was stacked, that they couldn't address the plenary sessions and that instructions from the White House, leaked to the press, showed a design to play down the dangers of global change.

Bromley. There was considerable discussion of this question of foreign-American participation. I think we should have had more foreign participation right up front in the beginning session. But every member had an opportunity, and

most of them took it, to speak in the working sessions.

What they objected to was that they didn't have full press coverage of their statement. And we did that with complete malice aforethought, because what we wanted was a working conference. We didn't want the whole series of formal presentations on behalf of country X, which is what we got at Noordwijk. What we wanted was to get people to address the actual problems we were trying to discuss. And I think we succeeded in very large measure in those working group sessions.

Although there was some unhappiness, particularly at the beginning, toward the end of the conference, I think most people were prepared to agree that we really had made progress here in understanding one another and the scientific, the economics, and the environmental communities actually were talking to one another. And that marked something that I think was quite new. With respect to this [official guidance for the American delegation], that was just singularly dumb all around.

SGR. What was dumb?

Bromley. Preparing the damn thing in the first place. This was what happens when you get some "experts" who tell you how to handle press relations. And they handed out these things, a child's guide to what they thought press relations were. Nobody paid much attention to them in the delegation. They were there, they were leaked, they gave a very simplistic view of what we were trying to do.

SGR. Who prepared those instructions?

Bromley. Some low-level staffer somewhere in the system. I don't know who.

SGR. In the White House press operation, not in your office?

Bromley. Certainly not in my office.

SGR. NIH says its study sections are approving 95 percent of applications. With that approval rate, wouldn't it be advantageous to disband the study sections and devote its budget to research?

Bromley. What you're seeing is an attempt on the part of the study sections to do a little gamesmanship. It's the perversion of the peer-review system, and it's one that in the long run will be damaging. But it reflects the view of the people who serve on these sections that too few young people are getting supported and therefore they'll try to redress the situation by inflating the review process. It's a mistake.

SGR. It's been going on for years.

Bromley. No, it's much worse now. The approval rate, I don't know how many years ago, was once about 68 percent, and now it's up around 95. So, there has been a substantial change, let's say, in the last five years.

SGR. Is there any way to get the study sections to stop inflating grades?

Bromley. That's what the NIH Director would, I anticipate.

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... Urges Scientists to Lobby to Raise R&D Funding

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pate, take as a major purpose. First of all, the real strength of American science and technology remains the small project, the individual investigator. I'm also very concerned that, at a time when we're trying to convince more young people to stay in academic careers, the success rate of funding at both NSF and NIH has dropped to the lowest levels since the war years. It sends a terrible message. I hope that in this coming year, even before that, we can begin to take some special action to try and improve that success rate. And certainly in the next budget year to tilt the priorities a bit in favor of the small-project research.

SGR. *How do the mega-projects fit with that goal?*

Bromley. The mega-projects are not totally unrelated to these young people, because they're the facilities they're going to want to use five and ten years from now. And if we weren't building those, the same people would be screaming that we're not investing in their research future. It's a balancing act. What we have to do is to tilt the balance a bit toward the individual investigator. The second thing is, I remain totally convinced that this country is under-investing in its science and technology base. If you look at civilian R&D and compare it with what's going on in Japan and Germany, for example, we're substantially below. That's the fundamental case we have to make. We've got to put more resources into this investment in our future. And if we can do that, then we can handle the individual investigator better than we are now, and we can continue with the mega-projects.

SGR. *You have testified on several occasions that this is not the time to cut defense R&D.*

Bromley. Absolutely. In fact, now is the time to increase the fundamental science and technology in the Defense Department. I maintain that this is the time when the Defense Department should be rebuilding its bridges with the universities, back more like they were in the 1950s, for example.

Paying for the SSC

SGR. *When you testified before the Senate Energy Committee on the Superconducting Super Collider (SSC), Senator Bumpers [D-Ark.] said that no one has yet explained how we're going to pay for it. You didn't offer an explanation [SGR May 15, "SSC vs. Other Needs: Bromley Collides with Senate Skeptics"].*

Bromley. What I really come back to is the fact that we, as a nation, are going to have to invest more than we are right now in our science and technology base, or we're not going to be able to have a science and technology base that Senator Bumpers and everybody else wants us to have.

SGR. *That's a call to arms, but still the question is where are we going to get the money when Gramm-Rudman dic-*

tates deficit reductions?

Bromley. I understand all that. But nonetheless, it's clear that we have to develop a constituency for science and technology. That's what it really comes down to, because I think we've really done rather well by science and technology in the President's budget this year. What we have to do is make sure that in fact the Congress appropriates this kind of funding. They're not going to do that unless they hear from their constituents who are concerned, not about getting something for themselves and not rattling tin cups, but ones who write thoughtful letters and come and visit them and say, "Look, we have a serious problem here and we want you to know about it."

What I'm trying to do, with a lot of other people, is to sensitize a lot of our colleagues out there in the scientific and engineering communities that this is important. It could be letter-writing or visiting. What I want people to do is what I used to do when I was back in Connecticut [at Yale], namely, every two weeks sit down with my Congressman for lunch. Whether we had anything on the agenda or not, we simply talked. He claimed it was very useful to him and I know it was certainly useful to me.

It's the development of trust over a period of time, the personal contact, that I think is important. Because in a lot of the discussions that go on in the Congress about a lot of the elements of the science and technology budget, frequently there is no one around with any specific interest or knowledge of the item involved. And if there's been this, if you like, grassroots development and contact, it will make a difference.

SGR. *In the four Associate Directorships at OSTP, there's none for national security.*

Bromley. We have an Assistant Director. That was done quite consciously, because the fact is we have a limited number of Associate Directorships.

In the traditional arrangement, it would have been an Associate Director for Defense Science rather than one for Industrial Technology. I felt that in today's world, that it was important to have one for Industrial Technology, both because I think that's a very important area; secondly, because I wanted to send a real message that this Administration is serious about that. And, thirdly, it reflects the fact that I anticipated that defense science was going to play a smaller role in OSTP than it has in recent times when Bill Graham [OSTP Director 1986-88], for example, was very much interested in that; so was Jay Keyworth [OSTP Director 1981-86].

It seemed to me that in chatting with [National Security Adviser] Brent Scowcroft, and the NSC group, for example, that what our role should be was to cooperate strongly with the NSC, with the Space Council, pick those areas where there was really a strong science and technology component, focus on those, rather than trying to cover a very broad area.

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In Quotes: The Changing Nature of Defense R&D

Excerpts from Arming Our Allies: Cooperation and Competition in Defense Technology, a report published May 11 by the Congressional Office of Technology Assessment.

Perhaps the greatest change in the past decade is that technology leadership in defense has dispersed around the world. Today, the ability to produce advanced technology with military applications is widespread, and the United States is no longer the leader in some technologies that are vital to military systems. . . . The problems associated with technological leveling in the military sphere are linked closely to the fate of US technology and industrial leadership in general. A generation ago, US technology led the world, and military technology was unrivaled. Two trends have changed this picture substantially. The first is that military procurement no longer drives innovation in the United States; much leading-edge technology is now pulled forward by markets for consumer goods. Second, US manufacturing and sales have taken a back seat to foreign competition in one product line after another. Today, there are large areas in consumer electronics where the United States is not a significant player, and emerging technologies, such

as high-definition TV, where the United States may never get into the game.

This is a significant problem because the distinctions between military and non-military technology, industry, and markets are breaking down. If the United States cannot compete in international consumer markets, it will ultimately come to depend on foreign dual-use technology in the production of the next generation of weapons. . . .

In the context of diminishing defense dollars and worldwide overcapacity [for weapons production], demands that Congress do something to assist the domestic defense industry are certain to mount, particularly as Congressional districts register the impact of increased international competition and decreased production, and most directly when plants close and jobs evaporate.

These demands will be difficult to resist, and will emanate from different sectors of the defense industry. They are likely to defy panacean remedies, and will probably create conflicting initiatives within the executive branch. . . .

Arming Our Allies: Cooperation and Competition in Defense Technology (GPO Stock No. 052-003-01189-1; 37 pp., \$5). Order from: USGPO, Superintendent of Documents, Washington, DC 20402; tel. 202/783-3238.

Bromley

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That remains the philosophy.

SGR. For the coming budget cycle, what are your major priorities?

Bromley. We have an important role to help the President in trying to improve math and science education. Another is materials science and engineering. Almost everything we do in this country is limited by the behavior of materials. It's an orphan field. It doesn't fit neatly into any agency or scientific discipline. We have an obligation to try and take a broad overview, try and get some coherence into the system.

Another area is biotechnology. It's a rapidly growing area and has the potential to be as important in the next few decades as electronics was. It may not realize that potential, but we have to look, first of all, at the basic science. We have to look at the regulations, because regulations are going to be extremely important, not only internally in this country, but in terms of how they compare with the ones in other countries with whom we trade.

Also very high on our priorities is the development of high-performance computing and communications, which we spelled out in the report we sent to Congress last fall [*The Federal High-Performance Computing Program*—SGR, October 1, 1989]. First we want to maintain the lead we have in the hardware for high-performance computing. Second, we want to get on with broad-band networking this country, so

that we can make the power available to small industries that can't get it now, to education in a major way, to a lot of universities that can't get it now.

But there are real problems we have to address. One is that most of the software that's available for use with high-performance computing is anything but friendly. It's been invented by *mavens*. We've got to get that redeveloped. And we're running into a real shortage of people trained to work at the frontiers. We may have enough people who can actually use keyboards and what-not, but [not enough] people who are going to move us forward.

SGR. Russians are said to be great at software. Are we taking specific steps to bring them over here?

Bromley. Russians have traditionally, in the absence of computers, developed fantastic skills in applied mathematics. And some of them certainly will be helpful. We're not taking specific steps to go recruit software experts, to my knowledge. But we're receptive to their interests and there are a significant number already on board at MIT and at Princeton and at Carnegie-Mellon.

SGR. Isn't immigration likely to be the easy solution to our manpower shortages?

Bromley. In the short term, it's the only solution, because we know the people who are in the [US educational] pipeline now. We have to go back and improve our educational system. But in the interim, we're going to depend more and more on the people who are going to join us from abroad. No question about that.

SGR. In all fields?

Bromley. In all fields.

More in Print: Neurotoxicity, Groundwater, Hughes

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power, funding, grant awards, etc.

Order from: NSF, Forms and Publications Unit, Room 232, 1800 G St. NW, Washington, DC 20550; tel. 202/357-7668.

Neurotoxicity: Identifying and Controlling Poisons of the Nervous System (GPO Stock No. 052-003-01184-1; 361 pp., \$15), by the Congressional Office of Technology Assessment (OTA), produced at the request of half a dozen Congressional committees, this is the first of a "neurosciences series," arising, OTA says, from "the disturbing realization that many commonly used chemicals can adversely affect the human nervous system." Based on a survey of federal agencies, OTA concluded that government research on the subject is inadequate and that training of researchers is undersupported. Regarding the effectiveness of the Federal Toxic Substances Control Act (TSCA), OTA reported that from 1977 to 1988, "final rules were issued on only 25 chemicals, consent agreements were reached on three, with nine proposed rules pending. Clearly," OTA stated, "these rules address only a very small fraction of the 60,000 chemicals in the TSCA inventory."

Congress, which has designated the 1990s as "The Decade of the Brain," is primed to take off on this issue. Accompanying release of the OTA report were alarmed, indignant statements from various legislators, typical among them a declaration by Senator Albert Gore (D-Tenn.), Chairman of the Science and Transportation Committee's Subcommittee on Science, Technology, and Space: "Chronic neurotoxicity presents a health risk every bit as large and as tragic as cancer, yet, as this report reveals, almost nothing is being done about it. As from today, that will change."

Also from OTA: **Beneath the Bottom Line: Agricultural Approaches to Reduce Agrichemical Contamination of Groundwater** (GPO Stock No. 052-003-01191-3; 77 pp., \$4), says groundwater contamination from agricultural sources is a big and growing problem and is arousing a degree of public concern that's bound to raise pressures for federal action. The OTA report, labeled a "summary"—though of what it doesn't say—lists a variety of options, including the development of training programs for farmers, greater cooperation among federal agencies, and more research.

Order from: Superintendent of Documents, USGPO, Washington, DC 20402-93254; tel. 202/783-3238. Add 25 percent for overseas orders.

Annual Report of the Howard Hughes Medical Institute 1989 (56 pp., no charge), shows that the biggest philanthropy of them all had a good year, with the mother lode swelling from \$4.6 billion to \$5.8 billion over the year that ended in August 1989. Income rose from \$239 million to \$294 million, expenditures for medical research and supporting services increased from \$178 million to \$196 mil-

lion, while a special grants program, mainly for science education, expended about \$40 million in each year.

Order from: HHMI Office of Communications, 6701 Rockledge Dr., Bethesda, Md. 20817; tel. 301/571-0330.

25 US Graduate Students to Visit Japan Under New NSF Program

Twenty-five American graduate students in science and engineering will spend eight weeks in Japan this summer under a new program aimed at getting Americans to make use of widening access to Japanese research organizations.

The program, sponsored by the National Science Foundation and the Science and Technology Agency of Japan, is an outgrowth of the US-Japan Agreement on Cooperation in Science and Technology. Arduously negotiated in the closing years of the Reagan Administration, the agreement reflected US consternation over the large numbers of Japanese studying and conducting research in the US and the very small presence of American counterparts in Japan. The Japanese responded that Americans were failing to take up available positions in Japan, a situation acknowledged by American research managers, who attribute it to language difficulties and a preference of Americans to stick close to their career paths at home.

The summer program, running from June through August, will be located in Tsukuba, and will include working time in some of Japan's top government research centers. The host laboratories are in Japan's Agency of Industrial Science and Technology, the Environment Agency, Ministry of Agriculture, Forestry and Fisheries, the Ministry of Education on Science and Culture, and the Science and Technology Agency. The students, from a wide variety of disciplines, were selected by NSF in a national competition.

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In Print: University Research, Japan's R&D Strategy

The publications listed are obtainable as indicated—not from SGR.

The Academic Research Enterprise Within the Industrialized Nations: Comparative Perspectives (115 pp., \$15), papers from a symposium held last year by the Government-University-Industry Research Roundtable, an offshoot of the National Academy of Sciences, with the focus on the conduct of research in universities, how it's organized, financed, and linked to the economy. The nations covered are the US, Japan, USSR, UK, West Germany, and France. Among items included under the heading of Major Trends: Europe and the Pacific Rim nations are outpacing the US in rates of growth for civilian research; the narrowing time span between basic research and commercialization is creating pressure for universities to develop closer ties to industry, and many big-science projects have become "prohibitively expensive for single nations to sponsor." For a quick survey of how the major industrialized nations manage academic research, this is the book.

Order from: National Academy Press, 2101 Constitution Ave. NW, Washington, DC 20418; tel. 1-800/624-6242; in Washington, DC, 334-3313.

Health Care Systems in Transition: The Search for Efficiency (204 pp., \$30), basic data on health care in the 24 member nations of the Organization for Economic Cooperation and Development, including vital statistics, expenditures, insurance coverage, physician incomes, length of hospital stays for specific illnesses, patient-staff ratios, pharmaceutical consumption, etc.

Order from: OECD Publications and Information Center, 2001 L St. NW, Suite 700, Washington, DC 20036-4905; tel. 202/785-6323; also available from OECD offices and booksellers in major cities around the world.

Japan's Science and Technology Strategies and Policies (IB90053; 14 pp., no charge), from the Science Policy Research Division of the Congressional Research Service (CRS), a brief review of the organization and economics of science and technology in Japan, with many comparisons to S&T American style. The report notes that US spending on

non-defense research was about double that of Japan in 1987—\$67.5 billion vs. \$38.8 billion (a useful corrective to the widespread impression of the US lagging behind Japan in civilian research expenditures). But Japan is far ahead in R&D growth rates, and spent only \$300 million on military research while the US spent \$33 billion. The report also notes that in 1985, Japan spent 5.9 percent of its government R&D funds on "industrial development," while the US government spent 0.2 percent. Also noted is that "the importance of imported technology to Japan has been declining and it has been estimated that about 75 percent of all the technology Japan uses is now developed in Japan."

Also from the CRS, ***Issues in US Advanced Technology Policy: A Review of the National Advisory Committee on Semiconductors Report, A Strategic Industry at Risk*** (90-234 SPR; 17 pp., no charge), examines the call last year by the National Advisory Committee on Semiconductors for a larger federal role in the industry, noting that a debate over Washington's place in industrial technology has been going on inconclusively for over a decade. A big difference now, the report states, is increasing links between American and Japanese firms, and more sophistication on the part of Americans on how to cooperate and compete at the same time. The CRS report stresses, however, that Washington is still strongly divided on the issue. "The reassignment of the Director of DARPA to another DOD office," it states, "is seen by some as a move by Administration officials to reduce the role of DARPA in commercial technology development." The report was written by Glenn J. McLoughlin, who also coordinated preparation of the report on Japanese science and technology.

Order from: Science Policy Research Division, Congressional Research Service, Library of Congress, Madison Building, Washington, DC 20540; attn. Ms. Raap; tel. 202/707-7014.

Publications of the National Science Foundation (NSF 89-23, 29 pp., no charge), lists hundreds of publications issued by NSF and the National Science Board, its policymaking body, and tells how to order copies, almost all of which are free. Topics range from announcements of programs, rules, and regulations to reports on research man-

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